SINGAPORE SPORTS SCHOOL PRELIMINARY EXAMINATION SECONDARY 4 NORMAL (ACADEMIC)

CANDIDATE NAME			
CLASS		INDEX NUMBER	

SCIENCE **5105/04; 5107/04**

Paper 4 (Chemistry) **16 AUGUST 2021**

Papers 3 and 4: 1 hour 15 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.

Write in a dark blue or black pen on both sides of the paper.

You may use a soft pencil for any diagrams, graphs.

Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions in Section A and any **two** questions in Section B.

The use of an approved scientific calculator is expected, where appropriate.

In calculations, you should show all the steps in your working, giving your answer at each stage.

You are advised to spend no longer than 30 minutes on Paper 3.

You may proceed to answer Paper 4 as soon as you have completed Paper 3.

A copy of the Periodic Table is printed on page **10**.

At the end of the examination hand in your answers to Paper 3 and Paper 4 separately.

The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	/ 14
Section B	/16
Total	**30**

This document consists of **9** printed pages and **1** blank page.

For Examiner's Use

Section A

*Answer **all** the questions in the spaces provided.*

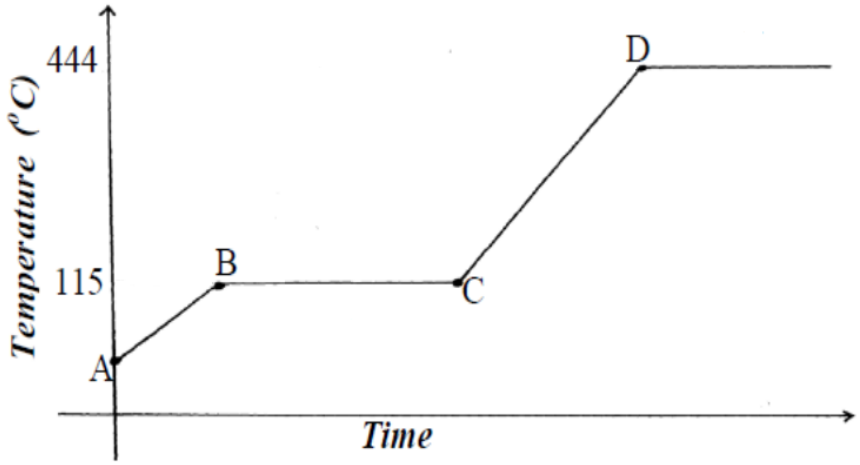
1 Sulfur is an *element* in Group VI of the Periodic Table.

(a) Define the term *element*.

.....

..... [1]

(b) The diagram below shows how the temperature changes as a sample of solid sulfur is heated.



(i) What is the boiling point of sulfur?

boiling point: ..... °C [1]

(ii) Between which **two** letters is there **only** solid present?

..... and ..... [1]

(iii) In terms of kinetic particle theory, explain what happens in the region from **B** to **C**.

.....

.....

.....

.....

..... [2]

[Total: 5]

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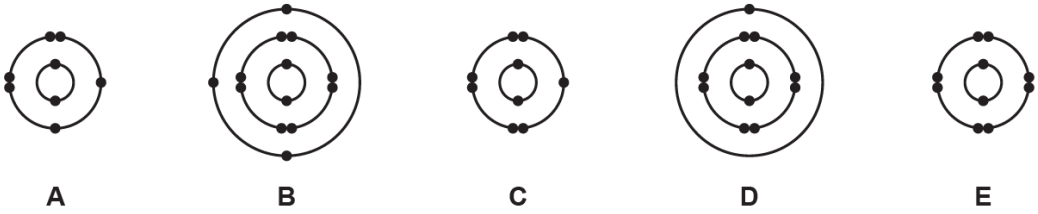
2 The electronic structures of five atoms are given below.



Answer the following questions about these atoms.

Each atom may be used once, more than once or not at all.

Which atom **A**, **B**, **C**, **D** or **E**,

(a) has a total of 8 electrons, ... [1]

(b) is in Group III of the Periodic Table, ... [1]

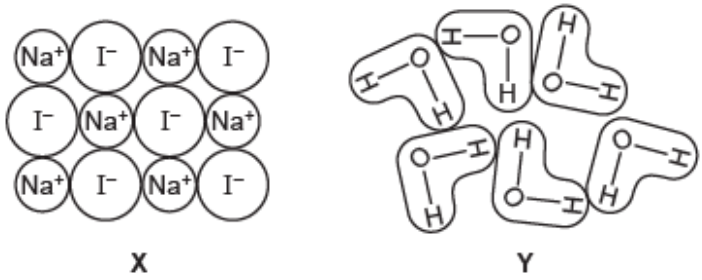
(c) has 11 protons in its nucleus, ... [1]

(d) is a noble gas, ... [1]

(e) forms a stable ion with a 1– charge? ..... [1]

[Total: 5]

3 The diagram shows part of the structures of two substances **X** and **Y**, at room temperature and pressure.



(a) In the space below, draw the "dot-and-cross" diagram for a molecule of substance **Y**. Show only the valence electrons.

[2]

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(b) Explain why substance **X** has a higher melting point than substance **Y**.

.....

.....

.....

.....

..... [2]

[Total: 4]

For Examiner's Use

Section B

*Answer any **two** questions from this section in the spaces provided.*

4 **(a)** Iron is extracted in the blast furnace commercially.

(i) What three raw materials are added to the top of the furnace?

1. .....
2. .....
3. ..... [2]

(ii) The waste gases from the blast furnace are tested using the following. The results are shown in the table below.

test conducted	observation
limewater	white precipitate
lighted splint	flame put out, no 'pop' sound heard
blue litmus paper	turned red
glowing splint	did not relight

What are two conclusions that can be made from these results?

1. .....
2. ..... [2]

(b) A student investigated the reactivity of four metals **G**, **H**, **K**, **L**, by reacting them with steam and cold water. The results are shown in the table.

Metal	Reaction with water	Reaction with steam
G	✓ (slowly)	✓
H	×	✓
K	×	×
L	✓ (very quickly)	✓

(i) Arrange the four metals in order of **decreasing** reactivity.

..... [2]

(ii) Name a metal that could be metal K.

..... [1]

(ii) A gas is produced when metal L reacts with water.
Name this gas.

..... [1]

[Total: 8]

5 A student prepared magnesium sulfate ($MgSO_4$) crystals starting from magnesium carbonate. The student carried out the experiment in the following steps.

Step 1: Excess magnesium carbonate was added to a small volume of dilute sulfuric acid until no more magnesium carbonate would react.

Step 2: The resulting mixture was filtered and the filtrate was collected.

Step 3: The filtrate was heated until it was saturated.

Step 4: The hot filtrate was left to cool to room temperature and the crystals formed were removed.

(a) How did the student know that no more magnesium carbonate would react?

..... [1]

(b) Identify the residue in step 2.

..... [1]

(c) Name the method used to obtain the crystals formed in step 4.

..... [1]

[Turn over

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(d) What should the student do to ensure the crystals collected in step 4 were without contaminants?

.....

..... [1]

(e) Write a balanced chemical equation for this reaction.
Include state symbols.

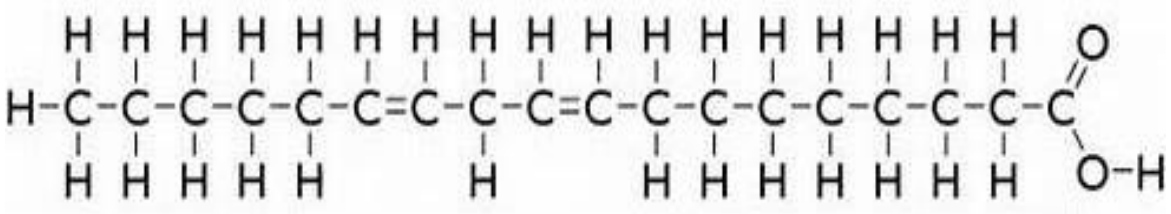
..... [2]

(f) 2.4g of magnesium sulfate crystals were collected at the end of the experiment. Calculate the number of moles of magnesium sulfate in 2.4g of magnesium sulfate.

[2]

[Total: 8]

6 Linoleic acid is an essential polyunsaturated fatty acid found mainly in plant oils like sunflower oil. It has the following structural formula.



(a) What is meant by the term *polyunsaturated*?

.....

..... [2]

(b) Describe a chemical test that proves that linoleic acid is unsaturated.
Chemical test:
.....
Result:
.....

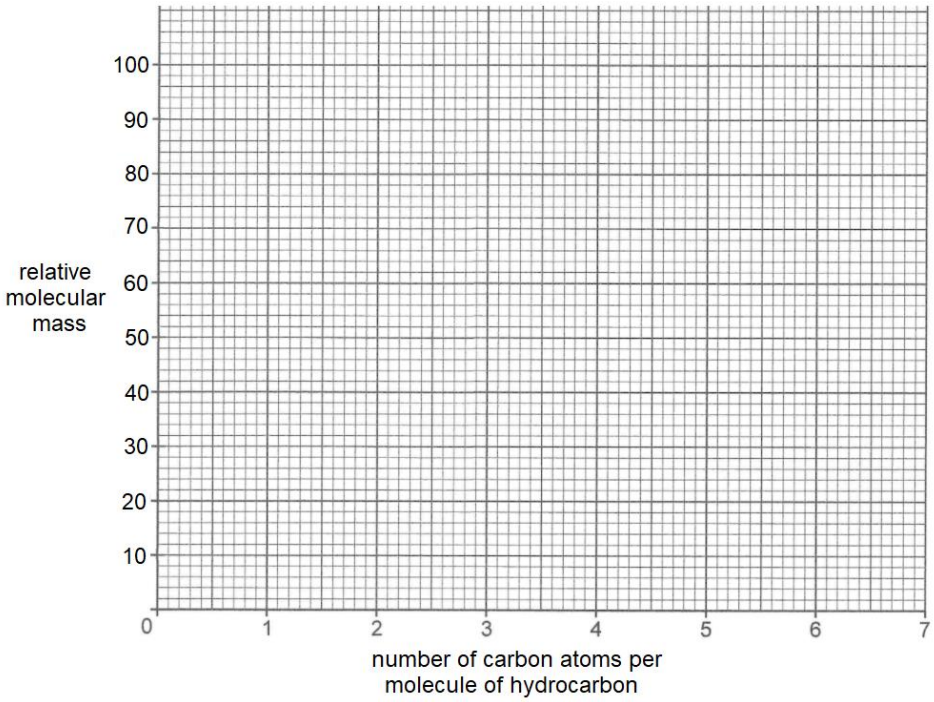
..... [2]

(c) The relative molecular masses and the number of carbon atoms of group of hydrocarbons are given below.

Number of carbon atoms per molecule of hydrocarbon	1	2	3	4	5	6	7
Relative molecular mass	16	26	44	58	?	86	100

(i) Plot a graph pf relative molecular mass against the number of carbon atoms per molecule of hydrocarbon, marking each point with a cross (x). [1]

(ii) Draw a line of best fit taking into account all your plotted points. [1]



(iii) Use your graph to find the relative molecular mass of the hydrocarbon with 5 carbons.

Relative molecular mass = …… [1]

(iv) One relative molecular mass value is not correct.
Circle it in your graph. [1]

[Total: 8]

------- **End of Paper** ------

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The Periodic Table of Elements

Group I	Group II						Group III	Group IV	Group V	Group VI	Group VII	Group 0
					1 H hydrogen 1							2 He helium 4
3 Li lithium 7	4 Be beryllium 9						5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24						13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).